AD-A091 964 FOREST PRODUCTS LAB MADISON WI F/G 11/12

DOES GANG RIPPING HOLD THE POTENTIAL FOR HIGHER CLEAR CUTTING Y--ETC(U)

MAY 80 H HALLOCK, P GIESE

UNCLASSIFIED FSRP-FPL-369 NL

END

DATE FILMED

1 81

DTIC

LEVEL II

12

United States Department of Agriculture

Forest Service

Forest Products Laboratory

Research Paper

FPL 369

May 1980

Does Gang Ripping Hold The Potential For Higher Clear Cutting Yields

AD A091964

ABSTRACT

Cutting yields from gang ripping hardwood lumber graded by the National Hardwood Lumber Association standard grades are determined using the technique of mathematical modeling. The lumber used is the same as that in an earlier mathematically modeled determination of cutting yields from traditional rough mill procedures. Mechanical cutting factors such as kerf, cutting lengths, and minimum salvage size are also the same in both studies. A comparison of yields between the two systems is made. While gang ripping produces higher total yields in all grades, the gain tends to be in the medium and shorter cutting lengths.

Key Words: Gang Ripping, Furniture Cutting Yields, Rough Mill, Mathematical Modeling, Hardwood Lumber

P-1

United States
Department of
Agriculture

Forest Service

**Forest
Products
Laboratory**[1]

Research
Paper

FPL 369

May 1980

(6)

(11)

Does Gang Ripping Hold The Potential For Higher Clear Cutting Yields.

(9) Forest Service Research Paper,

By

(10) **HIRAM HALLOCK, Research ~~Forest Products~~ Technologist ~~and~~ PAMELA GIESE, Computer Programer**

(14) FSRP-FPL-369

(12) 9

Introduction

When clear, one- or two-face furniture cuttings are the objective from factory grades of hardwood lumber,[2] the cutup procedure traditionally begins by crosscutting to maximize the desired cutting lengths in areas between knots. Crosscutting is followed by ripping the crosscut sections to desired cutting widths that are free of unacceptable defects. Residual from this step in the operation is then further defected by crosscutting and ripping either to smaller acceptable cuttings or to random-width strips of specified length and some specified minimum width for edge gluing into panels. These panels are then resawn to desired widths.

Although a few high-priced furniture lines require some of the cuttings, such as drawer fronts, to be one piece with no glue joints, this requirement is becoming the exception rather than the rule. Generally, random-width cuttings can be assembled and glued to form the final cutting item.

If one accepts edge gluing in all panels and for all cuttings, the possibility of another system to produce furniture cuttings can be considered. This system begins by mechanically gang ripping all the rough or skip-dressed lumber to some predetermined width presumably related to the lumber grade. From the ripped strips, cuttings of the desired lengths would be developed by crosscutting in the process of removing unacceptable defects. In most cases during gang ripping an edging strip less than full ripped strip width would be developed on the edge of the board farthest from the fence. If this strip were equal to or more than the minimum acceptable width for salvage, it would be included with the strips for crosscutting to desired cutting lengths. In some cases defective pieces removed in the crosscutting operation would contain a random-width strip less than the full gang ripped strip width that could be salvaged by additional crossсut and/or ripped to a narrower but acceptable width (fig. 1). Panels would then be edge glued from cuttings of the same length. These panels would be resawn to the desired final cutting width. Any part of the panel width remaining following the removal of all specified width cuttings would be recycled into the next panel to be glued up.

The gang ripping of hardwood lumber for certain products, such as flooring, is in widespread use. In the flooring industry all lumber is ripped to the desired width for a strip flooring blank and this operation is followed by crosscutting to remove unacceptable defects. No salvage of secondary cuttings is ordinarily made. Gang ripping of hardwood lumber for narrow moldings is also common.

Ripping first is almost universal in the softwood molding, millwork, and sash and door industry. Here, however, rip saw spacing is normally

[1] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[2] National Hardwood Lumber Association (NHLA) "Rules for the Measurement and Inspection of Hardwood and Cypress Lumber."

141700

mt

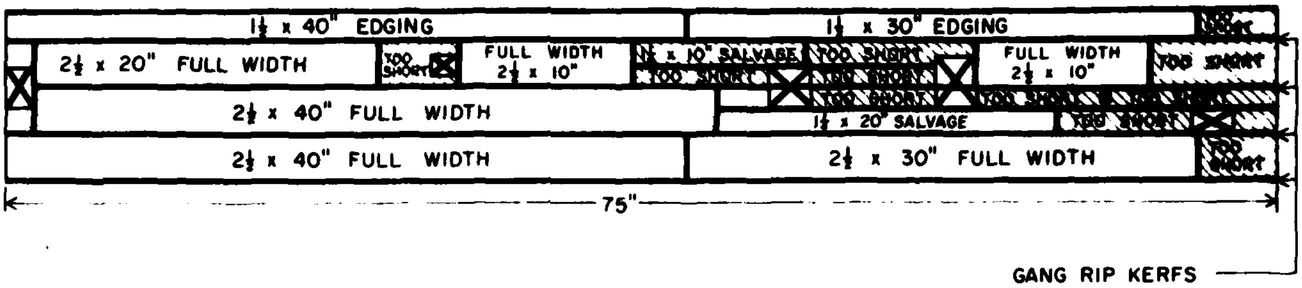

Figure 1.—Graphic representation of a board processed by the gang rip model illustrating the various types of cuttings found.

M 148 535

variable and reset for each board sawn. The reason for this results from the general industry practice that requires full-width cuttings (no edge-glued stock) and a much wider average width of softwood lumber as manufactured. Short lengths are finger jointed for increased recovery.

When gang ripping hardwood lumber several factors are involved that affect the final recovery in comparison to the conventional crosscut first system. The sawdust factor in most cases will be slightly higher with gang ripping. This is especially true if the ripping is to narrow widths. In theory, at least, total recovery (ignoring sawdust loss) increases as the cutting width is reduced because of lower defecting losses during the crosscutting operation. This becomes less a factor as cutting length is shortened since the chance of encountering a length-limiting defect is reduced. Compared to the conventional method, when sawdust losses are included in actual practice the theoretical gain in long length cuttings resulting from ripping narrow widths might be more than offset by the increased sawdust loss from more rip lines. As one would expect, there is a "best" rip width for each cutting length and lumber grade.

Mathematical modeling by computer has been used to determine the furniture cuttings from the various National Hardwood Lumber Association (NHLA) standard grades of hardwood lumber when cut up by the traditional method.[3456] Hard maple was the species chosen. Actual lumber chosen was selected to provide a statisticaly reliable representation of the quality and board size range found within each of the standard lumber grades. Yields were determined for all combinations of cutting size from 1 by 10 inches to 5-½ by 96 inches. Complete descriptive data defining the board and all its defects on both faces were reduced to a Cartesian (x,y) coordinate system and stored on cards.

The availability of this extensive board-descriptive data bank and the development of a mathematical model of the gang ripping process[7] has made possible the determination of cutting yield by this method. Since both the earlier modeling of the traditional method (program "YIELD")[3] and the current study use identical data and mechanical processing values, very valid yield comparisons are possible.

"MULRIP"—The Gang Ripping Model

Beginning at the lower edge of the board, with reference to its position when the board and defect data were recorded, a full-length 1/4-inch-wide strip is removed. A similar 1/4-inch strip is also removed from the upper edge. This procedure is identical to "YIELD" and is intended to account for the loss that would result from straightening up the cuttings adjacent to the edges of the board. The board is then "ripped" into lengthwise strips of a specified width. All strips are the same width except that part of the board outside the last sawline (edging) usually will be narrower than the other strips. If this strip is 1 inch or wider, it is saved. Each strip is separated by a ¼-inch kerf allowance, which is also the same as used in "YIELD." Thus, each ripped strip becomes a narrow, full-length board.

A series of cutting lengths is selected. Beginning with the longest cutting length, full strip-width cuttings are placed in the ripped strips wherever sufficient length exists between defects or the ends of the board and defects. When all possible cuttings of this length have been placed, the next longest cutting length is used. This is repeated until no full-width areas are left that are at least as long as the shortest cutting.

Next, to locate cuttings of less than full strip width a search is made of all the remaining areas that contain defects. A cutting is taken if the clear area is equal to or larger than the minimum size and can be removed by no more than one crosscut and one rip operation. (In removing the cutting up to two crosscuts and two rips are allowed if they can be performed without more than one change of operation between rip and crosscut stations: both crosscuts followed by both rips or vice versa.) When these steps have been followed the model assumes all available cuttings have been found. At this point the data are summarized and categorized by size of cutting; yield of full-length, full-width cuttings; cuttings salvaged from the edging area less than rip strip width; and cuttings salvaged from the defect areas.

---

[3] C. Wodzinski and E. Hahm, *A Computer Program to Determine Yields of Lumber* (Madison, Wis.: USDA For. Serv. Unnumbered publication, For. Prod. Lab., 1966).

[4] D. R. Schumann and G. H. Englerth, *Yields of Random Width Dimension from 4/4 Hard Maple Lumber* (Madison, Wis.: USDA For. Serv. Res. Pap. FPL 81, For. Prod. Lab., 1967).

[5] D. R. Schumann and G. H. Englerth, *Dimension Stock: Yields of Specific Width Cutting from 4/4 Hard Maple Lumber.* (Madison, Wis.: USDA For. Serv. Res. Pap. FPL 85, For. Prod. Lab., 1967).

[6] G.H. Englerth and D.R. Schumann, *Charts for Calculating Dimension Yields from Hard Maple Lumber.* (Madison, Wis.: USDA For. Serv. Res. Pap. FPL 118, For. Prod. Lab., 1969).

[7] The unpublished computerized model known as MULRIP was developed by A. Stern of FPL.

U.S. Forest Products Laboratory.

Does Gang Ripping Hold the Potential for Higher Clear Cutting Yields, by Hiram Hallock and Pamela Giese. Madison, Wis. FPL.
6 p. (USDA For. Serv. Res. Pap. FPL 369).

Makes a yields comparison between gang ripping and traditional rough mill procedures. Uses mathematical modeling and standard grade hardwood lumber graded by the National Hardwood Lumber Association. While gang ripping produces high total yields in all grades, gain tends to be in the medium and shorter cutting lengths.

U.S. Forest Products Laboratory.

Does Gang Ripping Hold the Potential for Higher Clear Cutting Yields, by Hiram Hallock and Pamela Giese. Madison, Wis. FPL.
6 p. (USDA For. Serv. Res. Pap. FPL 369).

Makes a yields comparison between gang ripping and traditional rough mill procedures. Uses mathematical modeling and standard grade hardwood lumber graded by the National Hardwood Lumber Association. While gang ripping produces high total yields in all grades, gain tends to be in the medium and shorter cutting lengths.

U.S. Forest Products Laboratory.

Does Gang Ripping Hold the Potential for Higher Clear Cutting Yields, by Hiram Hallock and Pamela Giese. Madison, Wis. FPL.
6 p. (USDA For. Serv. Res. Pap. FPL 369).

Makes a yields comparison between gang ripping and traditional rough mill procedures. Uses mathematical modeling and standard grade hardwood lumber graded by the National Hardwood Lumber Association. While gang ripping produces high total yields in all grades, gain tends to be in the medium and shorter cutting lengths.

U.S. Forest Products Laboratory.

Does Gang Ripping Hold the Potential for Higher Clear Cutting Yields, by Hiram Hallock and Pamela Giese. Madison, Wis. FPL.
6 p. (USDA For. Serv. Res. Pap. FPL 369).

Makes a yields comparison between gang ripping and traditional rough mill procedures. Uses mathematical modeling and standard grade hardwood lumber graded by the National Hardwood Lumber Association. While gang ripping produces high total yields in all grades, gain tends to be in the medium and shorter cutting lengths.

The Study

One of the objectives of this study was to compare yields of cuttings by the gang rip method with yields when the traditional method was used. Thus, all the cutting lengths for each of the lumber grades FAS, Selects, No. 1 Common, No. 2 Common, and No. 3A Common were held the same in this study as in the previous study.[4 5 6] These were as follows:

Grade	Cutting Lengths—inches
FAS	96, 90, 80, 70, 60, 50, 40, 30, 20, 10
Selects	96, 90, 80, 70, 60, 50, 40, 30, 20, 10
No. 1 Common	80, 70, 60, 50, 40, 30, 20, 10
No. 2 Common	40, 30, 20, 10
No. 3A Common	30, 20, 10

All cuttings were clear on two faces.

Yields were obtained for all gang ripping widths from 1-to 5-inch by 1/2-inch increments. For each of these widths, yields for each length of cutting were developed beginning with the longest cutting for that grade as the primary cutting length. Within each grade successive runs followed, each using successively shorter lengths as the primary cutting. For example, with No. 2 Common lumber the first run at a rip width of 1 inch used the 40-inch cutting length as the primary cutting length. The second run used 30 inches; the third, 20 inches; and the fourth, 10 inches. Then the rip width was increased to 1.5 inches and the series repeated. This continued until all rip widths through 5 inches had been completed. In each run yields for all secondary cutting lengths that were shorter than the primary cutting were also developed.

Results

As anticipated there is a relationship between the grade of the lumber, the length of the primary cutting, and the best width to gang rip as shown in tables 1 to 5. In all cases, and for all grades, best yields for the longer cuttings in each grade result from narrow ripping at a 1.0- or 1.5-inch width. Also shown are the ripping widths at which the poorest yields were obtained: always at 5.0 inches for the longer length cutting within each grade, switching to 1.0 inch at about midrange of the cutting lengths.

Differences between best rip width yields and poorest rip width yields are greatest for the longest and shortest cuttings in each grade and are appreciably lower in the midlength range. For example, in FAS grade for 96-inch cuttings, the best rip width is 9.1 percent better than poorest, and, for 10-inch cuttings, 15.5 percent better (table 1). However, for 60-inch cuttings the difference is only 4.2 percent. Comparable values for No. 2 Common are as follow: 40-inch cuttings, 8.3 percent; 10-inch cuttings, 11.4 percent; 20-inch cuttings, 4.7 percent (table 4).

In tables 6 to 10 the maximum yields obtainable from gang ripping for each cutting length are compared to those yields obtainable from the traditional manner as reported in USDA Forest Service Research Report FPL 118[6] for random-width cuttings (highest possible yield). For FAS grade, yields from gang ripping equal or exceed those from traditional processing for all except the 96-inch length, although there is little difference in any of the yields for lengths 70 inches and longer. Differences in the lengths below 60 inches become fairly significant (table 6). The yields from traditional processing exceed gang ripping in the Selects grade for cutting lengths of 80 or more inches. As in the FAS grade the medium and shorter lengths are obtained in significantly greater volume by gang ripping (table 7). When cutting yields from No. 1 Common grade are examined there is little difference between methods, although overall, gang ripping has a slight advantage. The trend relative to cutting lengths noted for FAS and Selects is not apparent for this grade (table 8). Differences in yield between the two methods for No. 2 Common grade, regardless of cutting length, are very small with a very slight margin in favor of gang ripping (table 9). Gang ripping yields for No. 3A Common grade are moderately superior in all cutting lengths with the margin tending to increase as length of cutting decreases (table 10). The results of an analysis of the

Table 1.—FAS grade—best and poorest product yields and ripping widths of specified length cuttings when gang ripping

Cutting length	Best rip width	Yield	Poorest rip width	Yield	Difference
In.	In.	Pct	In.	Pct	Pct
96	1.5	44.2	5.0	35.1	9.1
90	1.5	46.6	5.0	38.5	8.1
80	1.5	49.3	5.0	42.4	6.9
70	2.0	52.3	5.0	46.7	5.6
60	2.0	55.8	5.0	51.6	4.2
50	2.5	59.9	1.0	54.5	5.4
40	3.0	64.9	1.0	57.5	7.4
30	3.5	70.5	1.0	60.8	9.7
20	4.0	76.7	1.0	64.3	12.4
10	4.0	83.5	1.0	68.0	15.5

Table 2.—Selects grade—best and poorest product yields and ripping widths of specified length cuttings when gang ripping

Cutting length	Best rip width	Yield	Poorest rip width	Yield	Difference
In.	In.	Pct	In.	Pct	Pct
96	1.0	32.8	5.0	20.9	11.9
90	1.5	36.9	5.0	26.6	10.3
80	1.5	41.4	5.0	32.6	8.8
70	1.5	45.9	5.0	38.8	7.1
60	1.5	50.4	5.0	45.2	5.2
50	1.5	55.0	1.0	51.2	3.8
40	1.5	59.6	1.0	54.8	4.8
30	5.0	65.6	1.0	58.4	7.2
20	5.0	72.8	1.0	62.1	10.7
10	4.5	80.4	1.0	65.7	14.7

Table 3.—No. I. Common grade—best and poorest product yields and ripping widths of specified length cuttings when gang ripping

Cutting length	Best rip width	Yield	Poorest rip width	Yield	Difference
In.	In.	Pct	In.	Pct	Pct
80	1.0	26.9	5.0	13.4	13.5
70	1.0	31.2	5.0	18.2	13.0
60	1.5	36.0	5.0	24.4	11.6
50	1.5	41.5	5.0	31.8	9.7
40	1.5	47.6	5.0	40.5	7.1
30	1.5	54.1	1.0	50.3	3.8
20	3.5	62.6	1.0	55.5	7.1
10	4.5	73.8	1.0	60.9	12.9

Table 4.—No. 2 Common grade—best and poorest product yields and ripping widths of specified length cuttings when gang ripping

Cutting length	Best rip width	Yield	Poorest rip width	Yield	Difference
In.	In.	Pct	In.	Pct	Pct
40	1.0	32.1	5.0	23.8	8.3
30	1.5	40.7	5.0	34.2	6.5
20	2.5	49.8	1.0	45.1	4.7
10	3.5	63.4	1.0	52.1	11.3

Table 5.—No. 3A Common grade—best and poorest product yields and ripping widths of specified length cuttings when gang ripping

Cutting length	Best rip width	Yield	Poorest rip width	Yield	Difference
In.	In.	Pct	In.	Pct	Pct
30	1.5	26.5	5.0	22.7	3.8
20	1.5	37.8	5.0	34.7	3.1
10	1.5	52.7	1.0	44.0	8.7

Table 6.—FAS grade—comparison of yields of specified cutting lengths by the traditional and gang rip methods[1]

Cutting length	Traditional	Gang rip	Difference
In.	Pct	Pct	Pct
96	45.6	44.2	-1.4
90	46.5	46.6	0.1
80	48.2	49.3	1.1
70	50.4	52.3	1.9
60	52.5	55.8	3.3
50	55.8	59.9	4.1
40	60.0	64.9	4.9
30	64.9	70.5	5.6
20	70.1	76.7	6.6
10	76.8	83.5	6.7

[1] Cuttings are clear, two face, two edge.

maximum yields possible using the two systems, traditional, utilizing random widths and gang rip, using best overall rip width, are shown in table II and figure 2 for each of the lumber grades. In both cases best combination of lengths was assumed and does not necessarily include the longest cuttings used in the overall analysis of the grade yields. For FAS and Selects grades the longest cutting when gang ripped was 90 inches. The other three lower grades all used cutting mixes including the longest cuttings produced from the grade.

Gang ripping produces higher yields in all grades than does the traditional cut up system when a good selection of lengths is being cut. Largest margins are in the two top grades (7.8 and 8.9 percent) and the lowest grade (4.5 percent). Relatively small differences result in No. 2 Common grade (I percent), probably because of cutting bill lengths used. This aspect was not examined in the study reported here.

Discussion

Gang ripping can produce higher overall cutting yields from all grades of lumber. Unfortunately, this superiority, especially in the upper two grades, is a result of a substantially higher recovery in the medium and shorter lengths which offsets slightly lower recoveries in the longest length cuttings. Since the two upper grades are normally cut for long cuttings, the question arises regarding the desirability of gang ripping when cutting the two higher grades. Actually, most long furniture cuttings are not as long as the 90-and 96-inch cuttings included in the study. When these two lengths are ignored yields of long cuttings are at least equal to the traditional system and overall yields are higher.

Two other factors, not a part of this study, must necessarily be evaluated when deciding whether or not to gang rip. The first, favorable, is a reduction in both the number of rip stations in the rough mill and certainly in the labor requirement for ripping, since the initial gang ripping is mechanical. The second, unfavorable, is the probability that more adhesive will be required than in the traditional method where the average width of random-width cutting is probably wider than gang ripped cuttings.

Yields of primary and secondary cuttings from gang ripping standard grades of hardwood lumber are presented in charts within a separate publication: "Cutting Yields from Standard Hardwood Lumber Grades When Gang Ripping," USDA Forest Service Research Paper FPL 370.

3.0-5-7/80

Table 7.—Selects grade—comparison of yields of specified cutting lengths by the traditional and gang rip method[1]

Cutting length	Traditional	Gang rip	Difference
In.	Pct	Pct	Pct
96	37.0	32.8	-4.2
90	38.7	36.9	-1.8
80	41.5	41.4	-0.1
70	44.5	45.9	1.4
60	48.0	50.4	2.4
50	51.5	55.0	3.5
40	55.5	59.6	4.1
30	59.7	65.6	5.9
20	66.2	72.8	6.6
10	72.4	80.4	8.0

[1] Cuttings are clear, two face, two edge.

Table 8.—No. I Common Grade—comparison of yields of specified cutting lengths by the traditional and gang rip methods[1]

Cutting length	Traditional	Gang rip	Difference
In.	Pct	Pct	Pct
80	25.6	26.9	1.3
70	29.1	31.2	2.1
60	34.1	36.0	1.9
50	40.4	41.5	1.1
40	47.0	47.6	0.6
30	54.2	54.1	-0.1
20	62.9	62.6	-0.3
10	71.5	73.8	~~-2.5~~ 2.3

[1] Cuttings are clear, two face, two edge.

Table 9.—No. 2 Common grade—comparison of yields of specified cutting lengths by the traditional and gang rip methods[1]

Cutting length	Traditional	Gang rip	Difference
In.	Pct	Pct	Pct
40	33.0	32.1	0.9
30	39.0	40.7	1.7
20	49.4	49.8	0.4
10	62.5	63.4	0.9

[1] Cuttings are clear, two face, two edge.

Table 10.—No. 3A Common Grade—comparison of yields of specified cutting lengths by the traditional and gang rip methods[1]

Cutting length	Traditional	Gang rip	Difference
In.	Pct	Pct	Pct
30	25.0	26.5	1.5
20	36.8	37.8	1.0
10	48.3	52.7	4.4

[1] Cuttings are clear, two face, two edge.

Table 11.—All lumber grades—comparison of maximum cutting yields by traditional and gang rip methods[1]

Lumber grade	Traditional	Gang rip	Difference
	Pct	Pct	Pct
FAS	77.5	85.3	7.8
Selects	73.2	82.1	8.9
No. 1 Common	71.5	75.4	3.9
No. 2 Common	63.5	64.5	1.0
No. 3A Common	48.8	53.3	4.5

[1] All cuttings 1 by 10 inches and larger clear, two face, two edge.

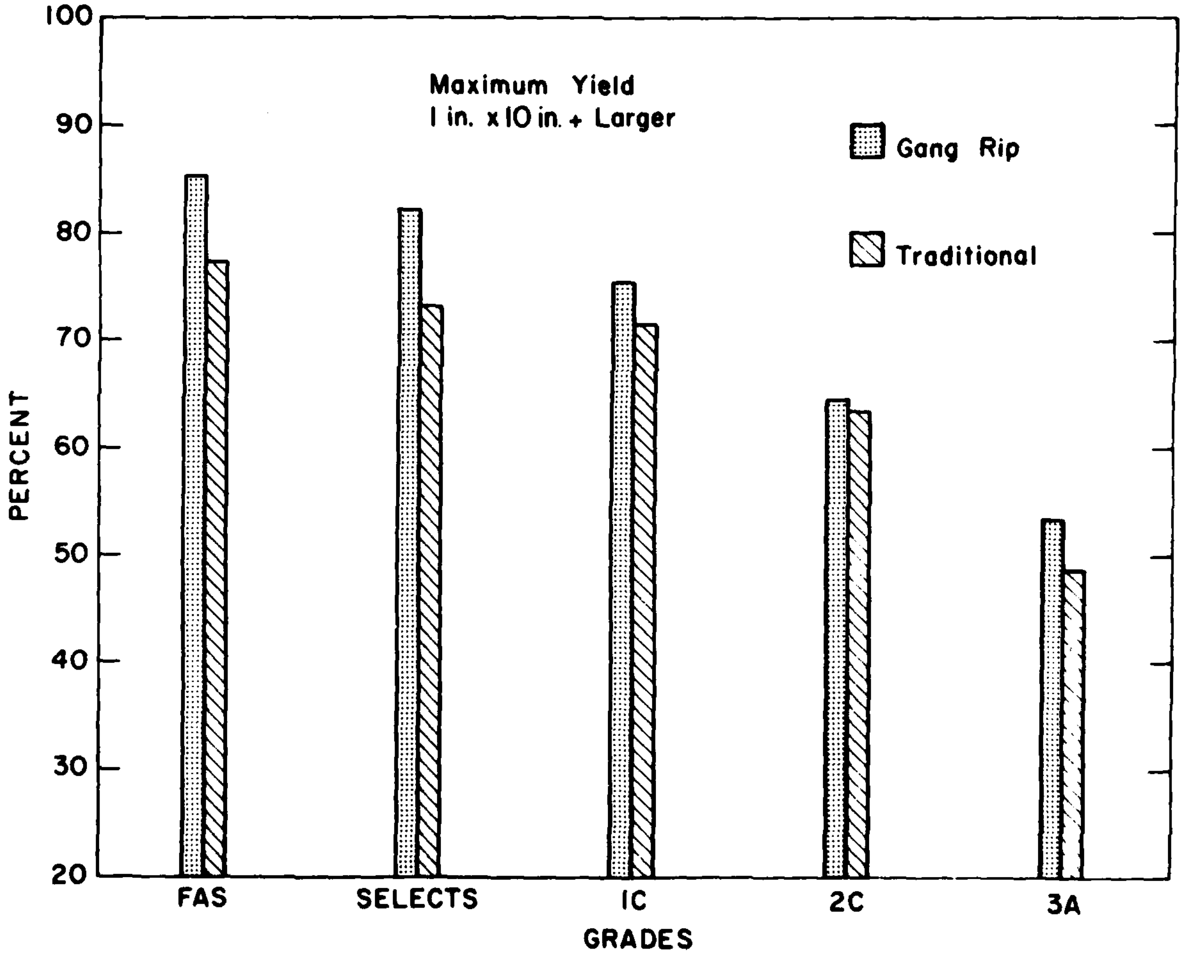

Figure 2.—Comparison of total cutting yields for each of the lumber grades when processed by the traditional and gang rip methods.

M 148 536

U.S. GOVERNMENT PRINTING OFFICE: 1980-651-111/5

D

FI